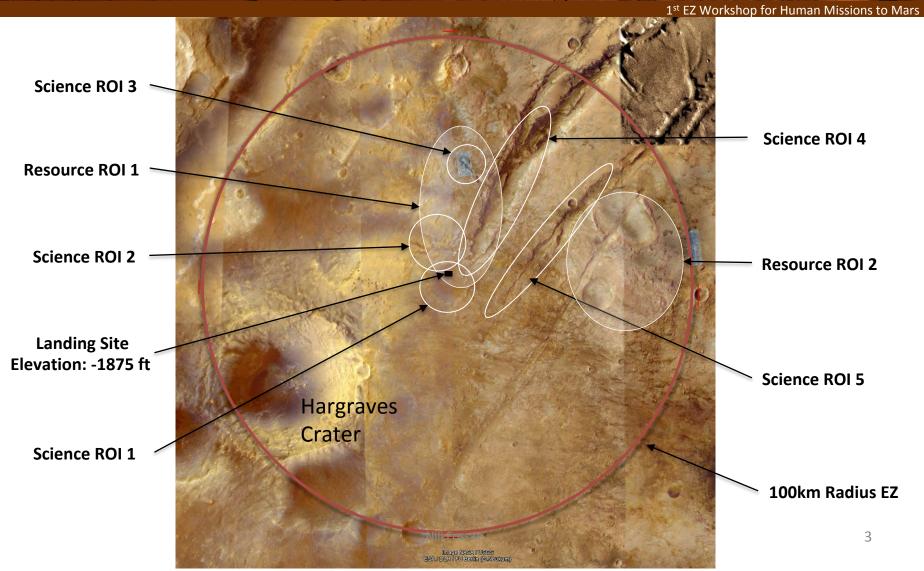


Nili Fossae Exploration Zone Map



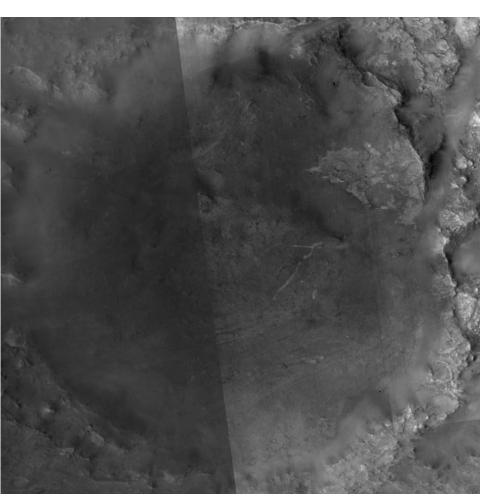


SCIENCE ROIs

Science ROI 1



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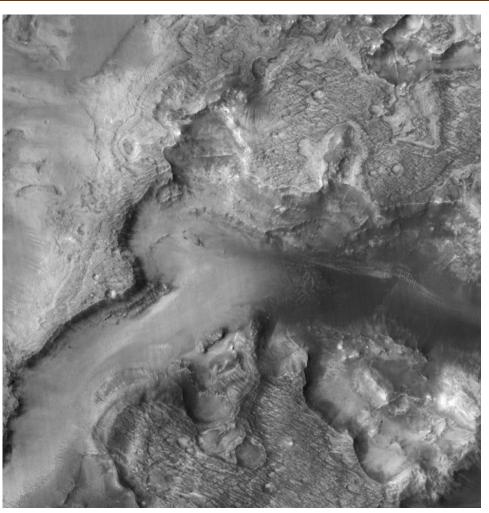


- 21.45°N 76.93°E
- Crater where proposed Landing Zone is located (Aprox. 15 km in diameter)
- Elevation is about -550 m
 - Thicker atmosphere than much of the planet for atmospheric studies.
 - Some adjoining canyon areas are about
 -1300m elevation
- Exposed bedrock in NE crater region
- Basalt (?) covering much of the crater area
- Fissure(?) where a lighter material is exposed
- Terrain (basalt?) layering in SSE crater area

Science ROI 2



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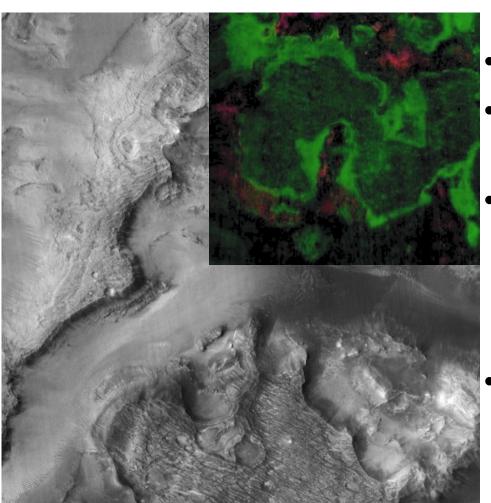


- 21.74°N 77.00°E
- Located aprox. 15 km NNE of LS (via ground)
- Canyon elevation ~
 -1100m
- Two possible paths into the canyon
- Exposed layering of sides of canyon walls
- Possible RSL on canyon walls

Science ROI 2 (cont)



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- 21.74°N 77.00°E
- CRISM image indicates the presence of water ice
- CRISM Image Legend
 - red = BD1900 (water ice or hydrated sulfates, clays, or glass)
 - green = BD1500 (water ice)
 - Possible location for microbial life forms

Science ROI 3





CRISM imagery available

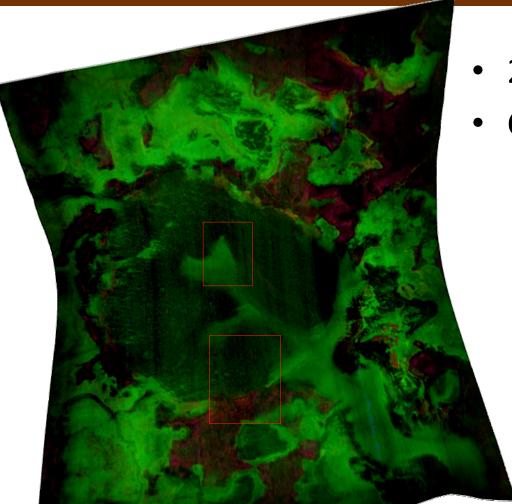
 Crust topping of unknown composition

 Appears to be a flow of material out of the canyon area

Science ROI3 (cont)



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- 22.25°N 77.06°E
- CRISM imagery available
 - FRT00003E12_07_IF166.ICE
 - red = BD1900 (water ice or hydrated sulfates, clays, or glass)
 - green = BD1500 (water ice)
 - blue=BD1435 (CO2 ice)

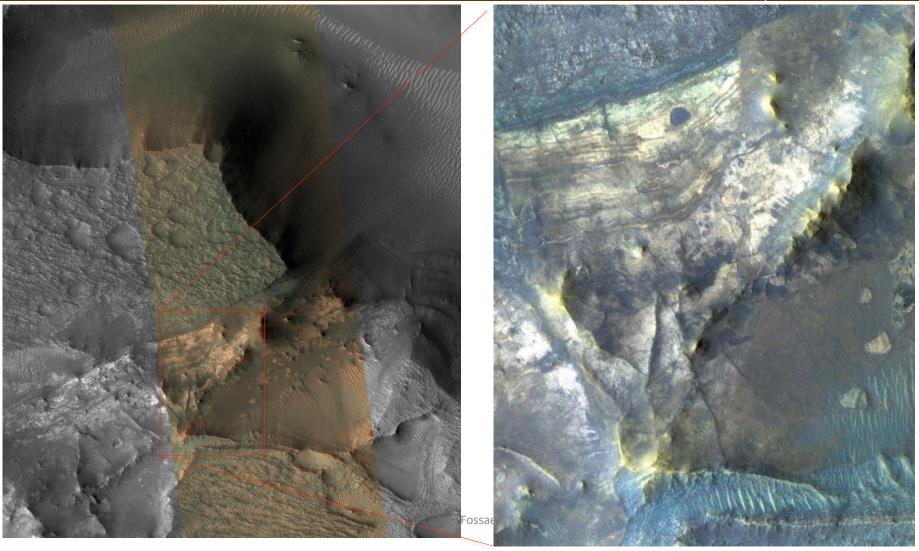
Science ROI3 (cont)





Science ROI3 (cont)

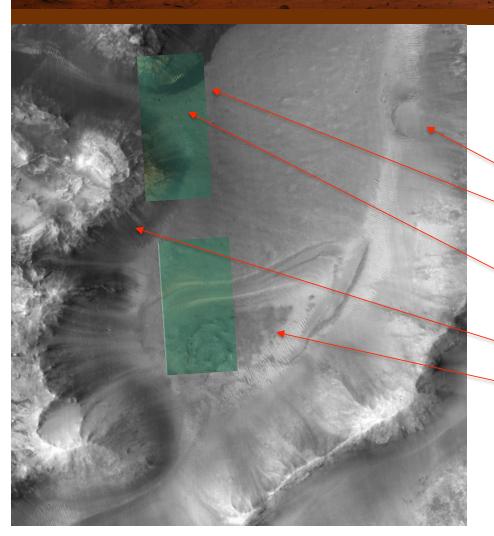
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Science ROI 4



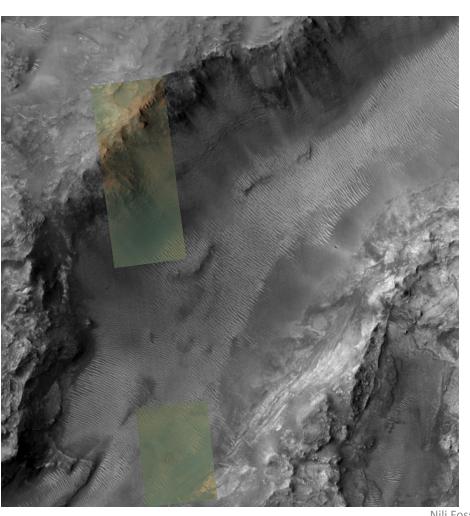
1st EZ Workshop for Human Missions to Mars



- 21.68°N 77.15°E
- Aprox. 16 km NE of LS
- HIRISE imagery available
- Small impact crater
- Cliffs with exposed strata on western canyon wall
- Small impact craters (and canyon entrance to ROI 2)
- Possible RSL on canyon walls
- 100m depression with exposed layers

Science ROI 5





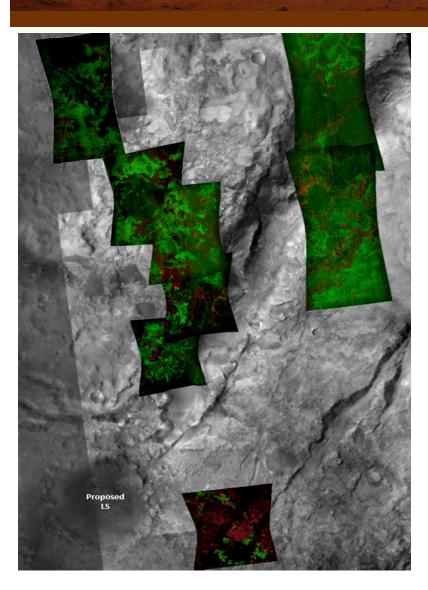
- 21.63°N 77.60°E
- HIRISE imagery available
- Cliffs with exposed strata on western canyon wall
- Possible RSL on western canyon wall
- Exposed layering of lighter material on eastern wall

RESOURCE ROIs

Resource ROI 1 - Water Ice



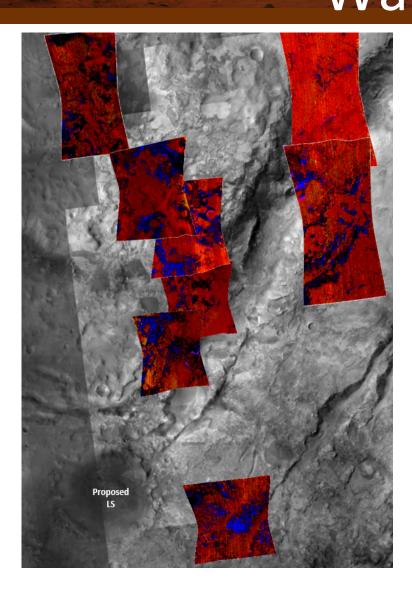
1st EZ Workshop for Human Missions to Mars



- 22.00°N 77.00°E (approximate center of image)
- These CRISM images in the region indicate the presence of water ice. If confirmed, this is key to long term habitation.
- Solves key resource criteria for water and fuel.
- Additional images would be needed to understand the extent of water ice closer to the LS.
- CRISM Image Legend
 - red = BD1900 (water ice or hydrated sulfates, clays, or glass)
 - green = BD1500 (water ice)
 - blue=BD1435 (CO2 ice)

Resource ROI 1 – Bound Water

1st EZ Workshop for Human Missions to Mars



- 22.00°N 77.00°E (approximate center of image)
- These CRISM images in the region indicate the presence of bound water and possible water ice.
- Primarily water-containing minerals in the region, with hydrated sulfates, clays, and/or glass scattered throughout the area.
- CRISM Image Legend
 - red = SINDEX (water-containing minerals or water ice)
 - green = BD2100 (monohydrated sulfates or water ice)
 - blue = BD1900nm. (hydrated sulfates, clays, glass, or water ice)

Resource ROI 1 — Hydroxylated Silicates



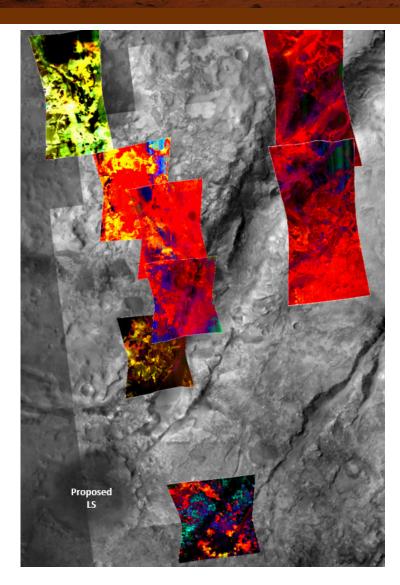


- 22.00°N 77.00°E (approximate center of image)
- These CRISM images show the extent of Hydroxylated Silicates in the region
- Seems to indicate an abundance of Fe/Mg phyllosilicates
- CRISM Image Legend
 - red = BD2300 (Fe/Mg phyllosilicate)
 - green = BD2210 (Al phyllosilicate or hydrated glass)
 - blue=BD1900 (hydrated sulfates, clays, glass, or water ice)

Resource ROI 1 – Mafic Mineralogy



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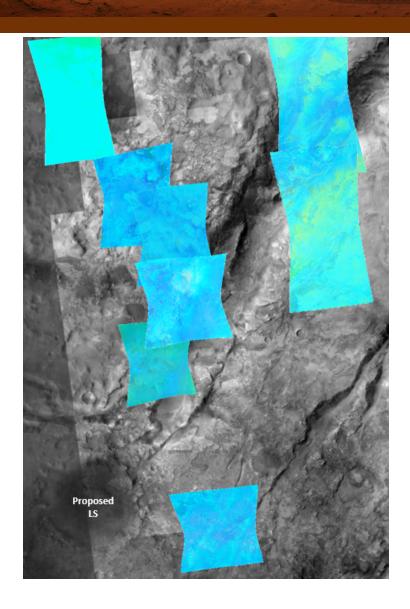


- 22.00°N 77.00°E (approximate center of image)
- These CRISM images show the extent of Mafic mineralogy in the region
- Seems to indicate an abundance of iron phyllosilicates (and/or olivine)
- Some areas of low and high Ca pyroxene is also indicated
- CRISM Image Legend
 - red = OLINDEX (olivine or iron phyllosilicates)
 - green = LCPINDEX (lowh-Ca pyroxene)
 - blue= HCPINDEX (highh-Ca pyroxene)

Resource ROI 1 – Oxidized Iron Minerals



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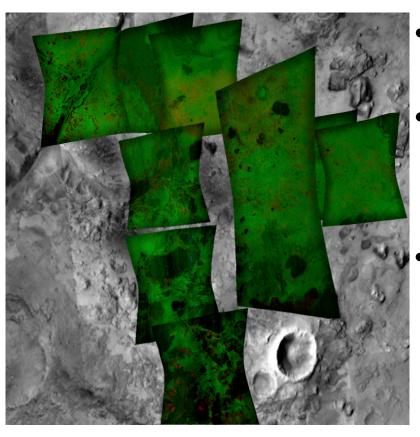


- 22.00°N 77.00°E (approximate center of image)
- These CRISM images show the extent of oxidized iron minerals in the region
- Continued theme of iron rich minerals are indicated
- CRISM Image Legend
 - red = BD530 (ferric minerals)
 - green = SH600 nm (coatings)
 - blue = BDI1000nm (variety of iron minerals)

Resource ROI 2 - Water Ice



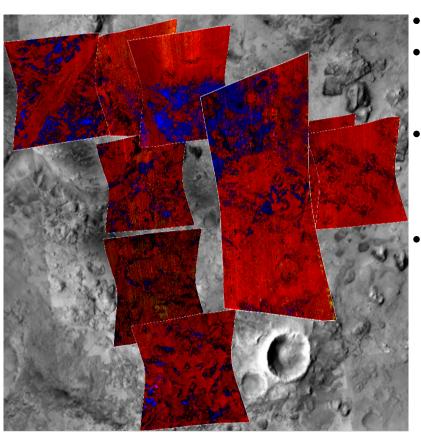
1st EZ Workshop for Human Missions to Mars



- 21.60°N 78.60°E (approximate center of image)
- These CRISM images in the region indicate the presence of water ice.
- CRISM Image Legend
 - red = BD1900 (water ice or hydrated sulfates, clays, or glass)
 - green = BD1500 (water ice)
 - blue=BD1435 (CO2 ice)

Resource ROI 2 – Bound Water

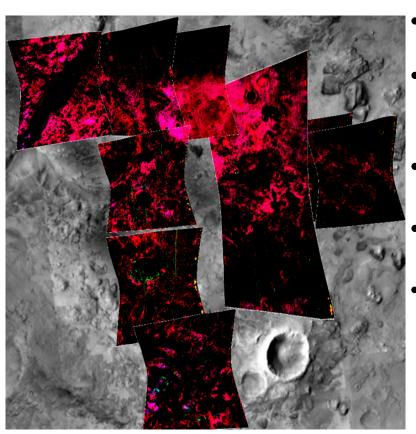
1st EZ Workshop for Human Missions to Mars



- 21.60°N 78.60°E (approximate center of image)
- These CRISM images in the region indicate the presence of bound water and possible water ice.
- Primarily water-containing minerals in the region, with hydrated sulfates, clays, and/or glass scattered throughout the area.
- CRISM Image Legend
 - red = SINDEX (water-containing minerals or water ice)
 - green = BD2100 (monohydrated sulfates or water ice)
 - blue = BD1900nm. (hydrated sulfates, clays, glass, or water ice)

Resource ROI 2 – Hydroxylated Silicates

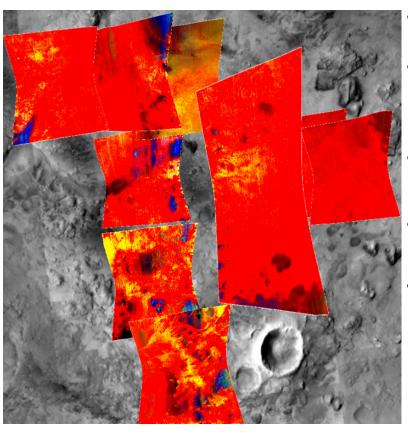




- 21.60°N 78.60°E (approximate center of image)
- These CRISM images show the extent of Hydroxylated Silicates in the region
- Primarily indicates the presence of Fe/Mg phyllosilicates
- Some small pockets of Aluminum phyllosilicate
- CRISM Image Legend
 - red = BD2300 (Fe/Mg phyllosilicate)
 - green = BD2210 (Al phyllosilicate or hydrated glass)
 - blue=BD1900 (hydrated sulfates, clays, glass, or water ice)

Resource ROI 2 – Mafic Mineralogy



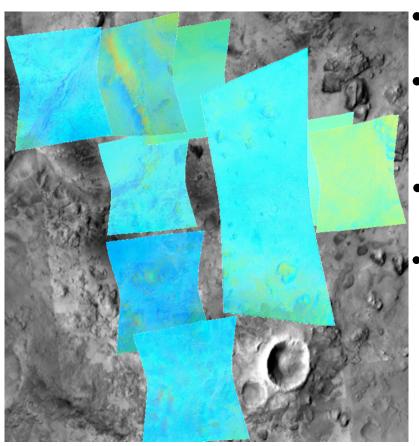


- 21.60°N 78.60°E (approximate center of image)
- These CRISM images show the extent of Mafic mineralogy in the region
- Indication of an abundance of iron phyllosilicates (and/or olivine)
- Small areas of low and high Ca pyroxene is also indicated
- CRISM Image Legend
 - red = OLINDEX (olivine or iron phyllosilicates)
 - green = LCPINDEX (low-Ca pyroxene)
 - blue= HCPINDEX (high-Ca pyroxene)

Resource ROI 2 – Oxidized Iron Minerals



1st EZ Workshop for Human Missions to Mar



- 21.60°N 78.60°E (approximate center of image)
- These CRISM images show the extent of oxidized iron minerals in the region
- Continued theme of iron rich minerals are indicated
- CRISM Image Legend
 - red = BD530 (ferric minerals)
 - green = SH600 nm (coatings)
 - blue = BDI1000nm (variety of iron minerals)

RUBRICS

Science ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars

	Site Factors							SROIS	RR011	RR012	EZ SUM
	Astrobio	Threshold	Potential for past habitability	?	•	•	•	•	•	•	6,0
			Potential for present habitability/refugia	?	•	•	•	•	•	•	6,0
	Ĭ ĕ	Qualifying	Potential for organic matter, w/ surface exposure		•	•	•	•	•	•	6,0
	Atmospheric Science	Threshold	Noachian/Hesperian rocks w/ trapped atmospheric gase	•	•	0	•	•	•	•	6,1
		Qualifying	Meteorological diversity in space and time	•	•	•	•	•	•	•	7,0
o l			High likelihood of surface-atmosphere exchange		•	•	0	0	•	•	5,2
teri			Amazonian subsurface or high-latitude ice or sediment		0	•	0	0	•	•	3,3
Criteria			High likelihood of active trace gas sources		•	•	•	•	•	•	6,0
Site	Geoscience	Threshold	Range of martian geologic time; datable surfaces	•	•	•	•	•	•	•	7,0
			Evidence of aqueous processes		•	•	•	•	•	•	6,0
Science			Potential for interpreting relative ages	•	•	•	•	•	•	•	7,0
Sci		Qualifying	Igneous Rocks tied to 1+ provinces or different times	•	?	?	?	?	•	•	3,0
			Near-surface ice, glacial or permafrost		•	•	0	0	•	•	4,2
			Noachian or pre-Noachian bedrock units	•	•	•	•	•	•	•	7,0
			Outcrops with remnant magnetization	•	?	?	?	?	•	•	3,0
			Primary, secondary, and basin-forming impact deposits	•			•		•	•	4,0
			Structural features with regional or global context	•	•	•	•	•	•	•	7,0
			Diversity of aeolian sediments and/or landforms	?	•	•	•	•	•	•	6,0

Key						
•	Yes					
0	Partial Support or Debated					
	No					
?	Indeterminate					

Resource ROI(s) Rubric

1st EZ Workshop for Human Missions to Mars

Site Factors							SR014	SROIS	RR011	RR012	EZ SUM	
	En	gineering	Meets First Order Criteria (Latitude, Elevation, Thermal Inertia)					•	•	•	7,0	
			Potential for ice or ice/regolith mix Potential for hydrated minerals	?	•	•	0	0	•	•	4,2	
				Potential for hydrated minerals	?	•	•	0	0	•	•	4,2
	ce		Quantity for substantial production		•	•	0	0	•	•	4,2	
	our	Threshold	Potential to be minable by highly automated systems		•	•	0	0	•	•	4,2	
<u>.</u> e	esc		Located less than 3 km from processing equipment site								0,0	
<u> </u>	Water Resource		Located no more than 3 meters below the surface	?	•	•			•	•	4,0	
ا يخ			Accessible by automated systems		•	•	?	?	•	•	4,0	
5			Potential for multiple sources of ice, ice/regolith mix and hydrated minerals		•	•			•	•	4,0	
5		Qualifying	Distance to resource location can be >5 km		•	•	•	•	•	•	6,0	
ב			Route to resource location must be (plausibly) traversable		•	•	•	•	•	•	6,0	
<u> </u>	Civil Engineering		~50 sq km region of flat and stable terrain with sparse rock distribution	•					0	0	1,2	
and Civil Engineering Criteria		Threshold	1-10 km length scale: <10°	•					0	0	1,2	
틸			Located within 5 km of landing site location	•					0	0	1,2	
<u> </u>			Located in the northern hemisphere	•	•	•	•	•	•	•	7,0	
ш		Qualifying	Evidence of abundant cobble sized or smaller rocks and bulk, loose regolith	?	•		•	•			3,0	
Ξ			Utilitarian terrain features	•	•		•	•	•	•	6,0	
[Food Production		Low latitude	•	•	•	•	•	•	•	7,0	
<u> </u>		Overlift days	No local terrain feature(s) that could shadow light collection facilities	•	•	•			0	0	3,2	
ק ו		호륁	Qualifying	Access to water	?	•	•	?	?	•	•	4,0
	Pro		Access to dark, minimally altered basaltic sands	?	•		?	?	0	0	1,2	
ISRU			Potential for metal/silicon	?	•				•	•	3.0	
K	_		Potential to be minable by highly automated systems	?	•				•	•	3.0	
ŭ	Metal/Silicon Resource	Threshold	Located less than 3 km from processing equipment site	•							1,0	
			Located no more than 3 meters below the surface	•	•				•	•	4,0	
			Accessible by automated systems	•	•				•	•	4,0	
			Potential for multiple sources of metals/silicon	0	•				•	•	3,1	
ľ	_	Qualifying	Distance to resource location can be >5 km	0	•				•	•	3,1	
			Route to resource location must be (plausibly) traversable	0	•				•	•	3,1	

Key								
Yes								
0	O Partial Support or Debated							
	No							
?	Indeterminate							

Highest Priority EZ Data Needs



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- Confirm the presence/quantity/quality of water ice
- If water ice and/or RSL are present, then determine if microbial life existed in the past, or currently exists.
- Determine what resources are available in and around the proposed Landing Site (CRISM imagery)
- HIRISE imagery to assess best location for a landing site, and the best location for the research site (smoothness of terrain, etc) in relation to resources
- Confirm potential of egress routes out of the landing site crater and to ROIs

BACKUP SLIDES

Prioritization List of EZ Data Needs



1st EZ Workshop for Human Missions to Mars

- Prioritized list of orbiter/rover data to be collected to assess the science potential of the EZ
 - X
- Prioritized list of orbiter/rover data to be collected to assess the resource potential of the EZ
- Need CRISM imagery to include the Landing Site area to asses the resources available in the immediate vicinity
- This data could be either from a current or future asset.
- If data to be collected are from existing assets please indicate:
 - HiRISE
 - CRISM
 - THEMIS
 - other

Provide a short justification as to what questions this will address.

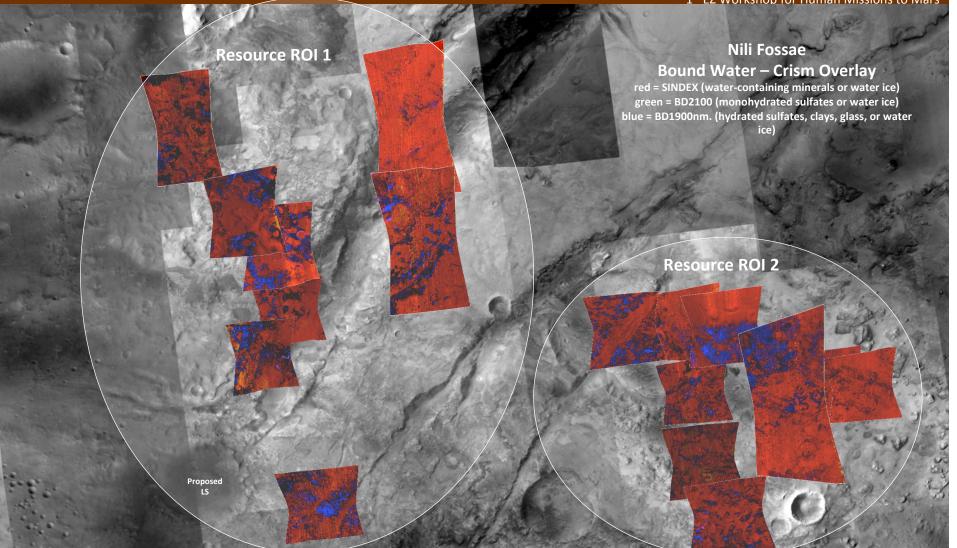


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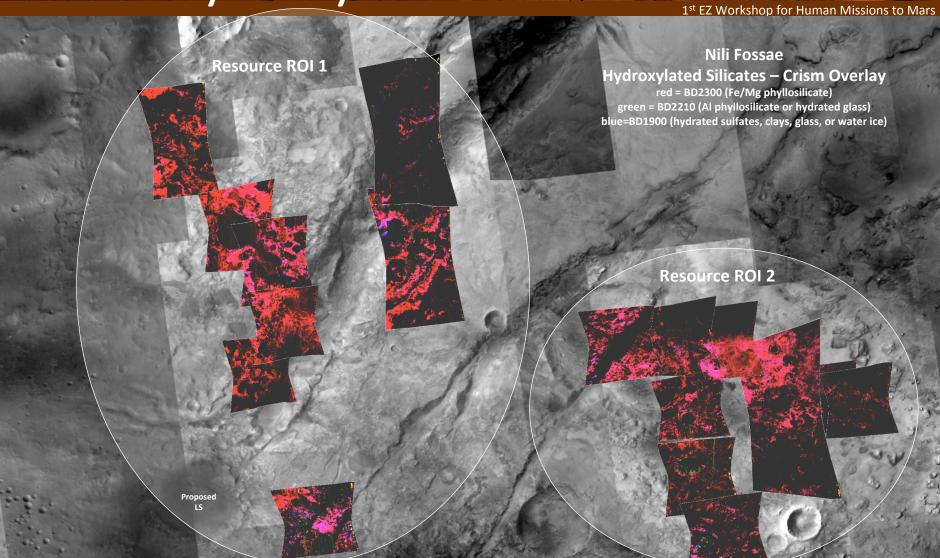
Nili Fossae **Resource ROI 1** Water Ice - Crism Overlay red = BD1900 (water ice or hydrated sulfates, clays, or glass) green = BD1500 (water ice) blue=BD1435 (CO2 ice) **Resource ROI 2**



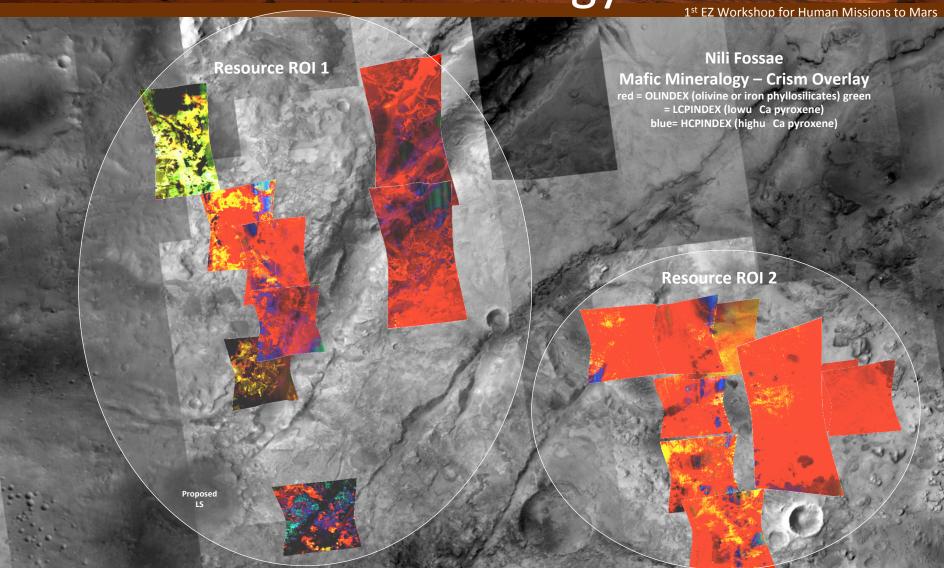
1st EZ Workshop for Human Missions to Mars



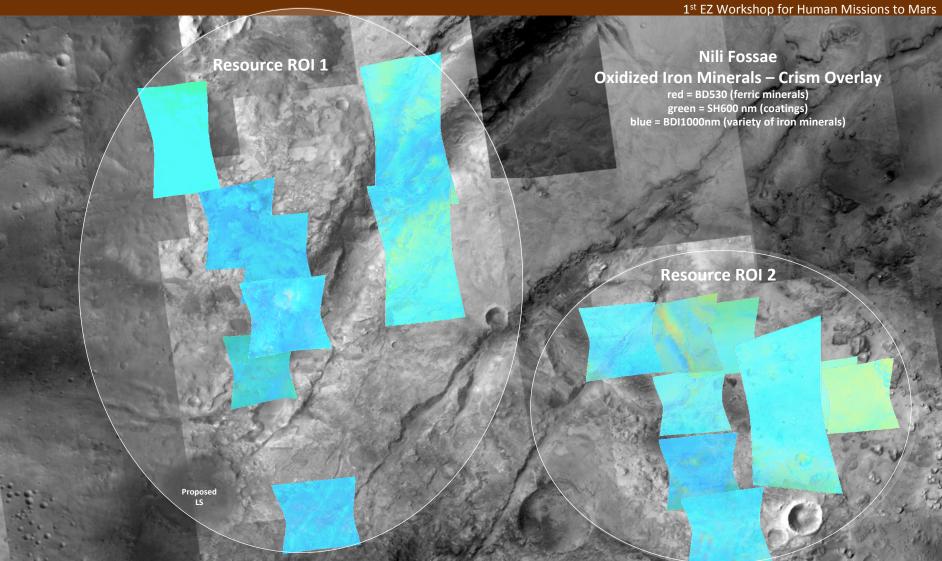












Available orbital datasets



Dataset	Instrument	Coverage	Spatial Res./Footprint	Where to look at
Surface images	HiRISE	2.4%	Res- 0.25-1 m/px Width- Red: 6km wide, Color: 1.2 km wide, Nominal length- 35km;	http://hirise.lpl.arizona.edu/ 1st EZ Workshop for Human Missions to Mars
	СТХ	95%	Res- 5 m/px Width- 30 km	http://global-data.mars.asu.edu/ bin/ctx.pl
	MOC (-2006)	6%	Res- <12 m/px	http://www.msss.com/moc_gallery/
	HRSC	>90%	Res- 10-60 m/px Swath width- 60 km	http://www.rssd.esa.int/PSA, http://ode.rsl.wustl.edu/mars/
NIR spectral data (e.g., composition)	CRISM	97% msp VNIR, to 36% hsp IR	Res- 20-200 (msp) m/px msp Footprint: 10 km x 45-540 km	http://crism.jhuapl.edu/gallery/ featuredImage/index.php
TIR spectral data (e.g, thermal inertia for rock counting, surface texture/ type, subsurface cavities)	TES (-2006)	Near global	Res- 3 km Width- 5.3, Length- 8.3 km	http://tes.asu.edu/data_archive.html
	THEMIS	Near global	Res- 100 m Width- 20 km	https://themis.asu.edu/gallery
Digital Terrain Models/slope maps	HiRISE	274 (there are more stereo images)	Meter-scale	http://www.uahirise.org/dtm/
	HRSC	75%	~50 m/px	http://hrscview.fu-berlin.de/
	MOLA (-2001 as altimeter)	global	100s m spacing of points	http://mola.gsfc.nasa.gov/
Radar	SHARAD	40%	Swath width- 3km, Depth res 10m, Depth pen 300m	http://pds-geosciences.wustl.edu/ missions/mro/sharad.htm
	MARSIS	80%	Swath width- 10km, Depth res 100m, Depth pen 1km	http://pds-geosciences.wustl.edu/ missions/mars_express/marsis.htm

Notes: Rows in orange are those that can be requested. Atmospheric datasets (not listed) are also available. Global maps can be found at: http://www.mars.asu.edu/data/. A useful tool for looking at and analyzing multiple datasets: http://jmars.asu.edu/data/.